Avaya Solution & Interoperability Test Lab

Application Notes for Configuring compressed Real Time Protocol over Multi-Link Point-to-Point Protocol between Juniper Networks J4300 and M7i routers to Support an Avaya IP Telephony Infrastructure – Issue 1.0

Abstract

These Application Notes describe the steps for configuring Juniper Networks J4300 and M7i routers to use compressed RTP (cRTP) over a Multi-Link Point-to-Point Protocol (MLPPP) connection to support an Avaya IP Telephony Infrastructure consisting of Avaya Communication Manager and Avaya IP Telephones. The Juniper Networks routers will perform header compression for all RTP traffic traversing over the MLPPP connection to minimize overhead used by the RTP packets thus increasing available bandwidth, and load distribution across the multi-link bundle for increase bandwidth and resiliency.

©2007 Avaya Inc. All Rights Reserved.

1. Introduction

Real Time Protocol (RTP) packets generated by Voice over IP (VoIP) telephony are typically small in size ranging in tens of bytes per packet. IP (20 bytes) and UDP (8 bytes) headers are then added onto each packet before transmission. Because of the relative small packet size of RTP packet, the IP and UDP headers are all overhead. For RTP packets that traverses a Wide Area Network (WAN) with limited bandwidth, these headers represents an opportunity for bandwidth saving that could otherwise be use for other traffic or additional VoIP calls. This is the main idea behind the use of cRTP.

It is most common to use the G.729 codec for calls across a low speed link due to its lower bandwidth requirement, but either G.711 or G.729 codecs can benefit from cRTP. Both G.711 and G.729 codec were exercised during compliance testing.

In addition, the Juniper J4300 and M7i router also has the ability to distribute VoIP traffic across all members on a per flow basis. The Juniper routers accomplished per flow load distribution through the examination of the 5tuples (Source/Destination IP, Source/Destination Port, and protocol) in each packet. Since these 5 pieces of information are the same for any given call flow, all rtp packets for a particular call will always be distributed onto the same multilink member. This is an important feature as members within a multilink bundle may be from different Service Provider and the links may have varying delay characteristic. Therefore, the ability of performing per flow load balancing can help minimize jitter in VoIP application.

Figure 1, shows the sample network used in these Application Notes. Two separate IP networks, one in each location are connected together by a pair of Juniper Networks routers over a MLPPP connection. Each location contains an Avaya Media Server, an Avaya Media Gateway, and Avaya IP Telephones. A dial plan and an H.323 trunk configured between the two Avaya Communication Managers allow calls to be routed between the two systems. Both the Juniper Networks M7i and J4300 routers are configured to perform RTP header compression for all RTP packets traversing over the PPP connection. Both routers are configured to prioritize VoIP traffic based on DiffServ Code Point (DSCP) information encoded in each VoIP packet. Bandwidth allocation was set on all interfaces shown to guarantee necessary bandwidth is reserved for VoIP traffic in the event of network congestion. Both Juniper routers will statistically distribute the call flows across all members of the MLPPP bundle. The combination of these elements provides the necessary Quality of Service for VoIP traffic traversing over the WAN connection.

©2007 Avaya Inc. All Rights Reserved.

2. Configuration

Figure 1 illustrates the configuration used in these Application Notes. Telephones with range number 3xxxx are registered with the Avaya S8300 Media Server on the right side of the figure, and telephones with extension range 2xxxx are registered with the Avaya S8500 Media Server on the left side of the figure. An H.323 IP trunk was used to route calls between the two Avaya Media Servers. Note that extensions from both Avaya Communication Manager systems are located in each location. This is done to verify the Avaya IP Telephones can register and place call successfully through a cRTP enabled WAN connection.

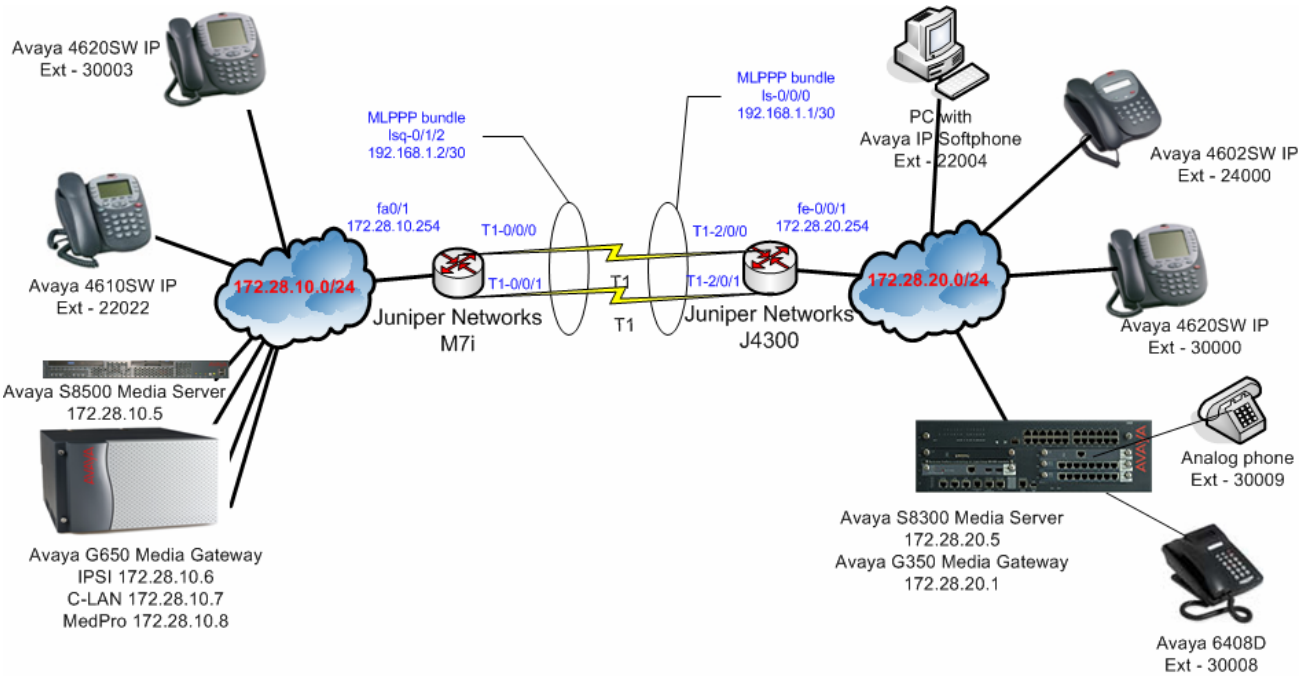

Figure 1: Sample Network Configuration

©2007 Avaya Inc. All Rights Reserved.

3. Equipment and Software Validated

The following equipment and software/firmware were used for the sample configuration:

Equipment	Software/Firmware
Avaya S8300 Media Server with G350 Media Gateway	Avaya Communication Manager R3.1.2 (R013x.01.2.632.1)
Avaya S8500 Media Server	Avaya Communication Manager R3.1.2 (R013x.01.2.632.1)
Avaya G650 Media Gateway	-
TN2312BP IPSI	HW03 FW 22
TN799DP C-LAN	HW01 FW 16
TN2302AP IP MedPro	HW18 FW 108
Analog telephone	N/A
Avaya 6408D digital Telephone	N/A
Avaya 4602SW IP Telephone (H.323)	R2.3 – Application (a10d01b2_3.bin)
Avaya 4610SW IP Telephone (H.323)	R2.6 – Application (a10d01b2_6.bin)
Avaya 4620SW IP Telephone (H.323)	R.2.6 – Application (a20d01b2_6.bin)
Avaya IP Softphone	R5.24.8
Juniper Networks J4300 router	JUNOS 8.1R1.5
Juniper Networks M7i router	JUNOS 8.1R1.5

©2007 Avaya Inc. All Rights Reserved.

4. Avaya Communication Manager

There is no unique configuration required in Avaya Communication Manager to support compressed RTP (cRTP) or any feature mentioned in this document. For detailed information on the Installation, Maintenance, and Configuration of Avaya Communication Manager, please consult reference [1], [2], and [3].

Step	Description
1.	Below is the output from the **display ip-network-region** command showing the **MEDIA PARAMETERS**, and **DIFFSERV/TOS PARAMETERS** information configured in Avaya Communication Manager. All traffic used in the sample network is configured for network region 1. The **Call Control PHB Value** of **34** is equivalent to 100010 in binary. The **Audio PHB Value** of **46** is equivalent to 101110 in binary. The **MEDIA PARAMETERS**, and **DIFFSERV/TOS PARAMETERS** information will be needed in later sections when configuring the routers.

```
display ip-network-region 1                                   Page   1 of  19
                              IP NETWORK REGION
  Region: 1
Location:         Authoritative Domain:
    Name:
MEDIA PARAMETERS                Intra-region IP-IP Direct Audio: yes
      Codec Set: 1              Inter-region IP-IP Direct Audio: yes
   UDP Port Min: 2048                     IP Audio Hairpinning? n
   UDP Port Max: 3029
DIFFSERV/TOS PARAMETERS                RTCP Reporting Enabled? y
 Call Control PHB Value: 34      RTCP MONITOR SERVER PARAMETERS
        Audio PHB Value: 46       Use Default Server Parameters? y
        Video PHB Value: 26
802.1P/Q PARAMETERS
 Call Control 802.1p Priority: 6
        Audio 802.1p Priority: 6
        Video 802.1p Priority: 5      AUDIO RESOURCE RESERVATION PARAMETERS
H.323 IP ENDPOINTS                                    RSVP Enabled? n
  H.323 Link Bounce Recovery? y
 Idle Traffic Interval (sec): 20
   Keep-Alive Interval (sec): 5
            Keep-Alive Count: 5
```


©2007 Avaya Inc. All Rights Reserved.

5. Configure the Juniper Networks Routers

The following sections describe the steps for configuring the different Juniper Networks routers in the sample configuration. Unless otherwise specified, all router configurations are based on Juniper Networks recommendation.

5.1. Configure the Juniper Networks J4300 Router

This section shows the necessary steps in configuring the Juniper J4300 router as shown in the sample network. The following steps use the Command Line Interface (CLI) offered by the J4300 router.

Step	Description

1.	Connect to the J4300. Log in using the appropriate Login ID and Password.
	
	`login:`
	`Password:`
	
	The following prompt will appears after successful log in.
	
	`interop@J4300>`

2.	Enter configuration mode by typing in **edit** at the prompt.
	
	`interop@J4300> edit`
	`interop@J4300#`

©2007 Avaya Inc. All Rights Reserved.

Step	Description

3.	Configure the **code-point-aliases** and **classifier** for Avaya VoIP traffic.
	
	• The alias helps identify the binary **dscp** setting.
	• The sample network uses the name "avaya-rtp" to denote dscp binary bit 101110 for media traffic. This is equivalent to the decimal Audio PHB Value of 46 set in Avaya Communication Manager for RTP Media in **Section 4, Step 1**.
	• The sample network uses the name "avaya-sig" to denote dscp binary bit 100010 for signaling traffic. This is equivalent to the decimal Call Control PHB Value of 34 set in Avaya Communication Manager for signaling in **Section 4, Step 1**.
	
	`interop@J4300# edit class-of-service code-point-aliases`
	`interop@J4300# set dscp avaya-rtp 101110`
	`interop@J4300# set dscp avaya-sig 100010`
	`interop@J4300# exit`
	
	• Define a **classifier** called "Avaya-voip".
	• The **classifier** "Avaya-voip" defines the forwarding characteristic used by the router based on traffic type.
	• The sample configuration is configured to use expedited-forwarding with low loss-priority for "avaya-rtp", and assured-forwarding with low loss-priority for "avaya-sig" to ensure proper Quality of Service (QoS) priority is assigned to voice traffic.
	
	`interop@J4300# edit class-of-service classifiers`
	`interop@J4300# edit dscp Avaya-voip`
	`interop@J4300# set forwarding-class expedited-forwarding loss-priority low code-points avaya-rtp`
	`interop@J4300# set forwarding-class assured-forwarding loss-priority low code-points avaya-sig`
	`interop@J4300# exit`

©2007 Avaya Inc. All Rights Reserved.

Step	Description

4.	Configure the scheduler to specify how much bandwidth to allocate for each type of traffic queue.
	
	• The sample configuration defines a **scheduler-maps** called "voip", and assigns a name for each of the 4 queues types.
	
	`interop@J4300# edit class-of-service scheduler-maps`
	`interop@J4300# edit voip`
	`interop@J4300# set forwarding-class best-effort scheduler be-sched`
	`interop@J4300# set forwarding-class expedited-forwarding scheduler ef-sched`
	`interop@J4300# set forwarding-class assured-forwarding scheduler af-sched`
	`interop@J4300# set forwarding-class network-control scheduler nc-sched`
	`interop@J4300# exit`
	
	• Use the scheduler to define the percentage of bandwidth allocation to each traffic queue type. These allocations are for testing purpose only. The actual bandwidth allocation should depend upon actual requirement.
	
	`interop@J4300# edit class-of-service schedulers`
	`interop@J4300# edit be-sched`
	`interop@J4300# set transmit-rate percent 10`
	`interop@J4300# set buffer-size percent 10`
	`interop@J4300# set priority low`
	`interop@J4300# exit`
	`interop@J4300# edit ef-sched`
	`interop@J4300# set transmit-rate percent 80`
	`interop@J4300# set buffer-size percent 80`
	`interop@J4300# set priority high`
	`interop@J4300# exit`
	`interop@J4300# edit af-sched`
	`interop@J4300# set transmit-rate percent 5`
	`interop@J4300# set buffer-size percent 5`
	`interop@J4300# set priority high`
	`interop@J4300# exit`
	`interop@J4300# edit nc-sched`
	`interop@J4300# set transmit-rate percent 5`
	`interop@J4300# set buffer-size percent 5`
	`interop@J4300# set priority high`
	`interop@J4300# exit`

©2007 Avaya Inc. All Rights Reserved.

Step	Description
5.	Assign the scheduler-map to each interface. • Configure each interface with **scheduler-map** voip using the classifier defined above. interop@J4300# ***edit class-of-service interfaces fe-0/0/1*** interop@J4300# ***set unit 0 scheduler-map voip*** interop@J4300# ***set unit 0 classifiers dscp avaya-voip*** interop@J4300# ***exit*** interop@J4300# ***edit class-of-service interfaces ls-0/0/0*** interop@J4300# ***set unit 0 scheduler-map voip*** interop@J4300# ***set unit 0 classifiers dscp avaya-voip*** interop@J4300# ***exit*** interop@J4300# ***edit class-of-service interfaces t1-2/0/0*** interop@J4300# ***set unit 0 scheduler-map voip*** interop@J4300# ***set unit 0 classifiers dscp avaya-voip*** interop@J4300# ***exit*** interop@J4300# ***edit class-of-service interfaces t1-2/0/1*** interop@J4300# ***set unit 0 scheduler-map voip*** interop@J4300# ***set unit 0 classifiers dscp avaya-voip*** interop@J4300# ***exit***

©2007 Avaya Inc. All Rights Reserved.

Step	Description

6.	Configure the Ethernet and T1 interfaces.
	
	• Configure the Ethernet interface to use the scheduler.
	• Assign an IP address to the interface.
	
	`interop@J4300# edit int fe-0/0/1`
	`interop@J4300# set per-unit-scheduler`
	`interop@J4300# set unit 0 family inet address address 172.28.20.254/24`
	`interop@J4300# exit`
	
	• Configure the logical interface for the WAN connection to use the scheduler.
	• Limit packet fragmentation of packet at 128 bytes.
	• Assigned an IP address to the interface.
	• Specify the RTP traffic to be compressed. The sample configuration defines RTP traffic with port range 2048 to 3029 to be compressed. This port range needs to match to **UDP Port Min** and **UDP Port Max** configured in Avaya Communication Manager in **Section 4, Step 1**.
	
	`interop@J4300# edit int ls-0/0/0`
	`interop@J4300# set per-unit-scheduler`
	`interop@J4300# set unit 0 fragment-threshold 128`
	`interop@J4300# set unit 0 compression rtp port min 2048 max 3029`
	`interop@J4300# set unit 0 family inet 192.168.1.1/30`
	`interop@J4300# exit`
	
	• Configure the T1 interfaces to use the scheduler.
	• Configure the T1 interfaces timing, encapsulation, and timeslots.
	• Configure the T1 interfaces to use logical interface ls-0/0/0.0 defined above. An IP address is not necessary because an IP address has already been defined for the logical interface.
	
	`interop@J4300# edit int t1-2/0/0`
	`interop@J4300# set per-unit-scheduler`
	`interop@J4300# set clocking external`
	`interop@J4300# set encapsulation ppp`
	`interop@J4300# set t1-options timeslots 1-24`
	`interop@J4300# set unit 0 family mlppp bundle ls-0/0/0.0`
	`interop@J4300# exit`
	`interop@J4300# edit int t1-2/0/1`
	`interop@J4300# set per-unit-scheduler`
	`interop@J4300# set clocking external`
	`interop@J4300# set encapsulation ppp`
	`interop@J4300# set t1-options timeslots 1-24`
	`interop@J4300# set unit 0 family mlppp bundle ls-0/0/0.0`
	`interop@J4300# exit`

7.	Configure the policy options. `interop@J4300# set policy-options policy-statmenet pplb then load-balance per-packet`

©2007 Avaya Inc. All Rights Reserved.

Step	Description

8.	Configure the routing options for the J4300 router and forwarding table. The sample configuration uses static routes.
	
	`interop@J4300# edit routing-options static`
	`interop@J4300# route 172.28.10.0/24 next-hop 192.168.1.2`
	`interop@J4300# set forwarding-table export pplb`
	`interop@J4300# exit`

9.	Save the changes. `interop@J4300# commit`

5.2. Configure the Juniper Networks M7i Router

This section shows the necessary steps in configuring the Juniper M7i router as shown in the sample network. The following steps use the Command Line Interface (CLI) offered by the M7i router.

Step	Description

1.	Connect to the M7i. Log in using the appropriate Login ID and Password.
	
	`login:`
	`Password:`
	
	The following prompt will appears after successful log in.
	
	`interop@M7I>`

2.	Enter configuration mode by typing in **edit** at the prompt.
	
	`interop@M7I> edit`
	`interop@M7I#`

©2007 Avaya Inc. All Rights Reserved.

Step	Description

3.	Configure the **code-point-aliases** and **classifier** for Avaya VoIP traffic.
	
	• The alias helps identify the binary **dscp** setting.
	• The sample network uses the name "avaya-rtp" to denote dscp binary bit 101110 for media traffic. This is equivalent to the decimal Audio PHB Value of 46 set in Avaya Communication Manager for RTP Media in **Section 4, Step 1**.
	• The sample network uses the name "avaya-sig" to denote dscp binary bit 100010 for signaling traffic. This is equivalent to the decimal Call Control PHB Value of 34 set in Avaya Communication Manager for signaling in **Section 4, Step 1**.
	
	`interop@M7I# edit class-of-service code-point-aliases`
	`interop@M7I# set dscp avaya-rtp 101110`
	`interop@M7I# set dscp avaya-sig 100010`
	`interop@M7I# exit`
	
	• Define a **classifier** called "Avaya-voip".
	• The classifier "Avaya-voip" defines the forwarding characteristic used by the router based on traffic type.
	• The sample configuration is configured to use expedited-forwarding with low loss-priority for "avaya-rtp", and assured-forwarding with low loss-priority for "avaya-sig" to ensure proper Quality of Service (QoS) priority is assigned to voice traffic.
	
	`interop@M7I# edit class-of-service classifiers`
	`interop@M7I# edit dscp Avaya-voip`
	`interop@M7I# set forwarding-class expedited-forwarding loss-priority low code-points avaya-rtp`
	`interop@M7I# set forwarding-class assured-forwarding loss-priority low code-points avaya-sig`
	`interop@M7I# exit`

4.	Configure the scheduler to specify how much bandwidth to allocate for each type of traffic queue.
	
	• The sample configuration defines a **scheduler-maps** called "voip", and assigns a name for each of the 4 queues types.
	
	`interop@M7I# edit class-of-service scheduler-maps`
	`interop@M7I# edit voip`
	`interop@M7I# set forwarding-class best-effort scheduler be-sched`
	`interop@M7I# set forwarding-class expedited-forwarding scheduler ef-sched`
	`interop@M7I# set forwarding-class assured-forwarding scheduler af-sched`
	`interop@M7I# set forwarding-class network-control scheduler nc-sched`
	`interop@M7I# exit`
	
	• Use the scheduler to define the percentage of bandwidth allocation to each traffic queue type. These allocations are for testing purpose only. The actual bandwidth allocation should depend upon actual requirement.

©2007 Avaya Inc. All Rights Reserved.

Step	Description
	interop@M7I# ***edit class-of-service schedulers*** interop@M7I# ***edit be-sched*** interop@M7I# ***set transmit-rate percent 10*** interop@M7I# ***set buffer-size percent 10*** interop@M7I# ***set priority low*** interop@M7I# ***exit*** interop@M7I# ***edit ef-sched*** interop@M7I# ***set transmit-rate percent 80*** interop@M7I# ***set buffer-size percent 80*** interop@M7I# ***set priority high*** interop@M7I# ***exit*** interop@M7I# ***edit af-sched*** interop@M7I# ***set transmit-rate percent 5*** interop@M7I# ***set buffer-size percent 5*** interop@M7I# ***set priority high*** interop@M7I# ***exit*** interop@M7I# ***edit nc-sched*** interop@M7I# ***set transmit-rate percent 5*** interop@M7I# ***set buffer-size percent 5*** interop@M7I# ***set priority high*** interop@M7I# ***exit***
5.	Configure the queue assignment for each traffic type. interop@M7I# ***edit class-of-service forwarding-classes*** interop@M7I# **set queue 0 best-effort** interop@M7I# ***set queue 1 expedited-forwarding*** interop@M7I# ***set queue 2 assured-forwarding*** interop@M7I# ***set queue 3 network-control*** interop@M7I# ***exit***

©2007 Avaya Inc. All Rights Reserved.

Step	Description
6.	Assign the scheduler-map to each interface. • Configure each interface with **scheduler-map** voip using **classifier** defined above. interop@M7I# ***edit class-of-service interfaces fe-1/3/0*** interop@M7I# ***set unit 0 scheduler-map voip*** interop@M7I# ***set unit 0 classifiers dscp avaya-voip*** interop@M7I# ***exit*** interop@M7I# ***edit class-of-service interfaces lsq-1/2/0*** interop@M7I# ***set unit 0 scheduler-map voip*** interop@M7I# ***set unit 0 classifiers dscp avaya-voip*** interop@M7I# ***exit*** interop@M7I# ***edit class-of-service interfaces t1-0/0/0*** interop@M7I# ***set unit 0 scheduler-map voip*** interop@M7I# ***set unit 0 classifiers dscp avaya-voip*** interop@M7I# ***exit*** interop@M7I# ***edit class-of-service interfaces t1-0/0/1*** interop@M7I# ***set unit 0 scheduler-map voip*** interop@M7I# ***set unit 0 classifiers dscp avaya-voip*** interop@M7I# ***exit***
7.	Define packet fragmentation rule for cRTP traffic. Turn off fragmentation for VoIP RTP packet which is tag as expedited-forwarding and assured-forwarding. interop@M7I# ***edit class-of-service fragmentation-map crtpLFI*** interop@M7I# ***set forwarding-class best-effort fragment-threshold 128*** interop@M7I# ***set forwarding-class expedited-forwarding no-fragmentation*** interop@M7I# ***set forwarding-class assured-forwarding no-fragmentation*** interop@M7I# ***set forwarding-class network-control fragment-threshold 128*** interop@M7I# ***exit***
8.	Configure the Ethernet and T1 interfaces. • Configure the Ethernet interface to use the scheduler. • Assign an IP address to the interface. interop@M7I# ***edit int fe-1/3/0*** interop@M7I# ***set per-unit-scheduler*** interop@M7I# ***set unit 0 family inet address address 172.28.10.254/24*** interop@M7I# ***exit*** • Configure the logical interface for the WAN connection to use the scheduler. • Assign an IP address to the interface. • Specify the RTP traffic to be compressed. The sample configuration defines RTP traffic with port range 2048 to 3029 to be compressed. This port range needs to match to **UDP Port Min** and **UDP Port Max** configured in Avaya Communication Manager in **Section 4, Step 1**.

©2007 Avaya Inc. All Rights Reserved.

Step	Description
	interop@M7I# ***edit int lsq-1/2/0*** interop@M7I# ***set per-unit-scheduler*** interop@M7I# ***set unit 0 compression rtp port min 2048 max 3029*** interop@M7I# ***set unit 0 family inet 192.168.1.2/30*** interop@M7I# ***exit*** • Configure the T1 interface timing, encapsulation, and timeslots. • Configure the T1 interface to use logical interface lsq-1/2/0.0 defined above. An IP address is not necessary because an IP address is already defined for the logical interface. interop@M7I# ***edit int t1-0/0/0*** interop@M7I# ***set clocking internal*** interop@M7I# ***set encapsulation ppp*** interop@M7I# ***set t1-options timeslots 1-24*** interop@M7I# ***set unit 0 family mlppp bundle lsq-1/2/0*** interop@M7I# ***exit*** interop@M7I# ***edit int t1-0/0/1*** interop@M7I# ***set clocking internal*** interop@M7I# ***set encapsulation ppp*** interop@M7I# ***set t1-options timeslots 1-24*** interop@M7I# ***set unit 0 family mlppp bundle lsq-1/2/0*** interop@M7I# ***exit***
9.	Configure the forwarding-options. interop@M7I# ***set forwarding-options hash-key family inet layer-3*** interop@M7I# ***set forwarding-options hash-key family inet layer-4***
10.	Configure the routing options for the J4300 router. The sample configuration uses static routes. interop@M7i# ***edit routing-options static*** interop@M7i# ***route 172.28.20.0/24 next-hop 192.168.1.1*** interop@M7i # ***exit***
11.	Save the changes. interop@M7i # ***commit***

©2007 Avaya Inc. All Rights Reserved.

6. Verification Steps

The following steps may be used to verify the configuration.

Step	Description
1.	Verify network connectivity. All network devices should be reachable.

2.	Use the **show service crtp flows** command on the Juniper router to verify traffic is being compressed. For an active phone call, there should be at least two flows displayed, one transmits and one received.
	
	`interop@J4300> show services crtp flows`
	`Interface: Interface: ls-0/0/0.0`
	`  Flow  Source  Destination  SSRC ID  Ctx ID`
	`  Transmit  172.28.20.128:2300  172.28.10.128:2594  1847753485  7`
	`  Receive  172.28.10.128:2594  172.28.20.128:2300  327775943  80`

3.	Use the **show interface queue** command on the Juniper router to verify traffic is being forward via the correct queue. Below output shows the information of an active phone call (50pps) being send out queue 1 (expedited-forwarding queue). Portion of the output concerning Queue 0, Queue 2, and Queue 3 have being abbreviated.
	
	`interop@J4311> show interfaces queue t1-2/0/0`
	`Physical interface: t1-2/0/0, Enabled, Physical link is Up`
	`  Interface index: 139, SNMP ifIndex: 34`
	`Forwarding classes: 8 supported, 8 in use`
	`Egress queues: 8 supported, 8 in use`
	`Queue: 0, Forwarding classes: best-effort`
	`  Queued:`
	`  Packets : 173342 150 pps`
	`  Bytes : 40575543 1784400 bps`
	`Queue: 1, **Forwarding classes: expedited-forwarding**`
	`  Queued:`
	`  **Packets : 46978 50 pps**`
	`  Bytes : 2361646 25944 bps`
	`  Transmitted:`
	`  Packets : 46978 50 pps`
	`  Bytes : 2361646 25944 bps`
	`  Tail-dropped packets : 0 0 pps`
	`  RED-dropped packets : 0 0 pps`
	`  Low : 0 0 pps`
	`  Medium-low : 0 0 pps`
	`  Medium-high : 0 0 pps`
	`  High : 0 0 pps`
	`  RED-dropped bytes : 0 0 bps`
	`  Low : 0 0 bps`
	`  Medium-low : 0 0 bps`
	`  Medium-high : 0 0 bps`
	`  High : 0 0 bps`
	`Queue: 2, Forwarding classes: assured-forwarding`
	`  Queued:`
	`  Packets : 217241 0 pps`
	`  Bytes : 12011825 0 bps`
	`Queue: 3, Forwarding classes: network-control`

©2007 Avaya Inc. All Rights Reserved.

Step	Description
	Queued: Packets : 9722 0 pps Bytes : 141217 0 bps
4.	Use the **show class-of-service forwarding-table** command to verify the bandwidth allocation has been assigned to each interface. The following output has been abbreviated to only show the relevant interfaces. The allocation of bandwidth should match what is configured in **Section 5.1** and **5.2, Step 4**. interop@J4300> **show class-of-service forwarding-table** Classifier table index: 12, # entries: 8, Table type: IPv4 precedence Entry # Code point Queue # PLP 0 000 0 0 1 001 0 1 2 010 0 0 3 011 0 1 4 100 0 0 5 101 0 1 6 110 3 0 7 111 3 1 Classifier table index: 6440, # entries: 2, Table type: DSCP Entry # Code point Queue # PLP 0 100010 2 0 1 101110 1 0 Table Index/ Interface Index Q num Table type sp-0/0/0.16383 66 12 IPv4 precedence ls-0/0/0.0 67 6440 DSCP fe-0/0/0.0 68 12 IPv4 precedence fe-0/0/1.0 69 6440 DSCP Interface: ls-0/0/0, (Index: 134,, Map index: 2,, Map type: FINAL,, Num of queue s: 2): Index: 0 Entry 0 (Scheduler index: 17, Queue #: 0): Tx rate: 0 Kb (95%), Buffer size: 95 percent Priority low PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1 Entry 1 (Scheduler index: 19, Queue #: 3): Tx rate: 0 Kb (5%), Buffer size: 5 percent Priority low PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1 Interface: fe-0/0/1, (Index: 138,, Map index: 2,, Map type: FINAL,, Num of queue s: 2): Index: 0 Entry 0 (Scheduler index: 17, Queue #: 0): Tx rate: 0 Kb (95%), Buffer size: 95 percent Priority low PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1 Entry 1 (Scheduler index: 19, Queue #: 3): Tx rate: 0 Kb (5%), Buffer size: 5 percent Priority low PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1

©2007 Avaya Inc. All Rights Reserved.

Step	Description

```
Interface: t1-2/0/0, (Index: 139,, Map index: 2,, Map type: FINAL,, Num
of queue
s: 2):
Index: 0
  Entry 0 (Scheduler index: 17, Queue #: 0):
    Tx rate: 0 Kb (95%), Buffer size: 95 percent
Priority low
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1
  Entry 1 (Scheduler index: 19, Queue #: 3):
    Tx rate: 0 Kb (5%), Buffer size: 5 percent
Priority low
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1

Interface: ls-0/0/0.0, (Index: 67,, Map index: 45418,, Map type: FINAL,,
Num of
queues: 4):
Index: 0
  Entry 0 (Scheduler index: 13005, Queue #: 0):
    Tx rate: 0 Kb (10%), Buffer size: 10 percent
Priority low
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1
  Entry 1 (Scheduler index: 62197, Queue #: 1):
    Tx rate: 0 Kb (80%), Buffer size: 80 percent
Priority high
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1
  Entry 2 (Scheduler index: 62165, Queue #: 2):
    Tx rate: 0 Kb (5%), Buffer size: 5 percent
Priority high
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1
  Entry 3 (Scheduler index: 45740, Queue #: 3):
    Tx rate: 0 Kb (5%), Buffer size: 5 percent
Priority high
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1

Interface: fe-0/0/1.0, (Index: 69,, Map index: 45418,, Map type: FINAL,,
Num of
queues: 4):
Index: 0
  Entry 0 (Scheduler index: 13005, Queue #: 0):
    Tx rate: 0 Kb (10%), Buffer size: 10 percent
Priority low
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1
  Entry 1 (Scheduler index: 62197, Queue #: 1):
    Tx rate: 0 Kb (80%), Buffer size: 80 percent
Priority high
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1
  Entry 2 (Scheduler index: 62165, Queue #: 2):
    Tx rate: 0 Kb (5%), Buffer size: 5 percent
Priority high
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1
  Entry 3 (Scheduler index: 45740, Queue #: 3):
    Tx rate: 0 Kb (5%), Buffer size: 5 percent
Priority high
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1

Interface: t1-2/0/0.0, (Index: 70,, Map index: 45418,, Map type: FINAL,,
Num of
queues: 4):
Index: 0
  Entry 0 (Scheduler index: 13005, Queue #: 0):
    Tx rate: 0 Kb (10%), Buffer size: 10 percent
Priority low
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1
```


©2007 Avaya Inc. All Rights Reserved.

Step	Description
	Entry 1 (Scheduler index: 62197, **Queue #: 1**): Tx rate: 0 Kb (80%), **Buffer size: 80 percent** Priority high PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1 Entry 2 (Scheduler index: 62165, **Queue #: 2**): Tx rate: 0 Kb (5%), **Buffer size: 5 percent** Priority high PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1 Entry 3 (Scheduler index: 45740, **Queue #: 3**): Tx rate: 0 Kb (5%), **Buffer size: 5 percent** Priority high PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1 RED drop profile index: 1, # entries: 1 Drop Entry Fullness(%) Probability(%) 0 100 100

7. Conclusion

These Application Notes have described the administration steps required to configure compressed Real Time Protocol (cRTP) to function between Juniper Networks M7i and J4300 routers over a Multi-link Point-to-Point Protocol (MLPPP) connection. Quality of Service was implemented by the use of DiffServ Code Point (DSCP) information for traffic priority queue assignment, and the use of bandwidth allocation on all the interfaces. There was no detectable different in voice quality between VoIP traffic that has gone through header compression and traffic that had not used header compression. Basic features such as Transfer, Conference, and DTMF detection continue to function over a cRTP enabled MLPPP environment. Per flow load distribution was successfully supported by both the J4300 and M7i routers.

©2007 Avaya Inc. All Rights Reserved.

8. Additional References

Product documentation for Avaya products may be found at http://support.avaya.com

[1] *Administrator Guide for Avaya Communication Manager*, Doc # 03-300509, Issue 2.1, May 2006

[2] *Avaya Communication Manager Advanced Administration Quick Reference*, Doc # 03-300364, Issue 2, June 2005

[3] *Administration for Network Connectivity for Avaya Communication Manager*, Doc # 555-233-504, Issue 11, February 2006

[4] *Avaya IP Telephony Implementation Guide*, May 1, 2006

Product documentation for Juniper Networks products may be found at http://www.Juniper.net

[5] *JUNOS™ Internet Software (CLI User Guide), Release 8.1*, Part Number 530-017052-01, Revision 1

[6] *JUNOS™ Internet Software (Class of Service Configuration Guide)*, Release 8.1, Part Number 530-017058-01, Revision 1

[7] *JUNOS™ Internet Software (Network Interfaces Configuration Guide)*, Release 8.1, Part Number 530-017057-01, Revision 1

[8] *JUNOS™ Internet Software (Services Interfaces Configuration Guide)*, Release 8.1, Part Number 530-017064-01, Revision 1

©2007 Avaya Inc. All Rights Reserved.

©2007 Avaya Inc. All Rights Reserved.
Avaya and the Avaya Logo are trademarks of Avaya Inc. All trademarks identified by ® and ™ are registered trademarks or trademarks, respectively, of Avaya Inc. All other trademarks are the property of their respective owners. The information provided in these Application Notes is subject to change without notice. The configurations, technical data, and recommendations provided in these Application Notes are believed to be accurate and dependable, but are presented without express or implied warranty. Users are responsible for their application of any products specified in these Application Notes.

Please e-mail any questions or comments pertaining to these Application Notes along with the full title name and filename, located in the lower right corner, directly to the Avaya Solution & Interoperability Test Lab at interoplabnotes@list.avaya.com